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Secretary
Federal Communications Commission
445 12th St., SW
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Ex Parte Filing Docket 04-186

Adaptrum submits the following comments regarding the wireless microphone issue in the TV white space proceeding, ET Docket 04-186, in response to a recent filing[1] by the White Space Coalition ("Coalition"). Adaptrum supports many key points raised in the Coalition's filing including the beacon-based wireless microphone protection mechanism. However, Adaptrum proposes to limit the beacon use to special events only and set aside a percentage of white space channels for broad wireless microphone uses[2].

Adaptrum has been an active participant in the TV white space proceeding and has submitted its white space prototype to the FCC Laboratory for the second phase of the white space device testing. Adaptrum prototype's sensing and transmit capabilities have been demonstrated both in the lab and in the field[3].

Wireless Microphone Protection Proposal

Adaptrum propose the following two-step protection for wireless microphones if white space devices are allowed in the TV bands:

1. Reserve certain percentage of white space channels for general wireless microphone use.

2. For special events, legal wireless microphone users may use beacons to claim additional white space channels when necessary.

[1] White Spaces Coalition *ex parte* filing , 6/17/08 http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520030268.

[2] Note that similar "safe harbor" approach was proposed in earlier comments by various parties including Google.

[3] Adaptrum *ex parte* filing, 6/2/08 http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520012216.

Nationwide, a percentage X of all TV channels between 2 and 51 (excluding certain off-limits channels like Channel 37) shall be reserved for wireless microphones. White space devices are not allowed to access any of these channels even if they are vacant in a local area. White space devices can access the remaining (100-X) percent of the TV channels if they are vacant. The ratio X/(100-X) should reflect the perceived economic and societal value of the wireless microphones relative to that of the white space devices. The Commission may fix the percentage X from the beginning or change it over time to adapt to the market conditions and availability of alternative spectrum technologies for wireless microphones in the future.

The percentage assignments assume wireless microphones and white space devices have equal limits of access to the TV spectrum. If wireless microphones can access a greater set of the TV channels, for example, if channels 14 to 20 are considered accessible to wireless microphones but not to white space devices, the percentage assignments should be reapportioned accordingly to maintain the ratio.

For special events that require extensive wireless microphone use, e.g. broadcast sporting events, political conventions, and live performances using many audio channels, in-channel beacons can be used to claim additional white space channels, as long as these channels are efficiently used. All white space devices are required to recognize the beacon format and vacate the channels where beacons are present. The beacon transmitters can be placed at convenient high points and the beacon signals are set at adequate levels so as to cover the entire event arena.

The beacon format proposed by the Coalition can be used as a reference. We propose to increase the upper limit of beacon transmit power from 16 dBm to 27 dBm or 0.5 W for improved reliability. Pending further measurements and study, the Commission can impose a minimum beacon detection threshold, which combined with the actual beacon transmit level will determine the coverage area of the beacon. We also think it is advantageous for the beacon to carry the identification[4] (e.g. a telephone number or call sign) of the beacon owner, which for example can be phase modulated onto the PN sequence recommended by the Coalition. The Commission may opt to avoid endorsing a specific beacon format, in which case, the Commission may consider specifying the beacon power level, bandwidth, and spectrum structure, e.g. white noise like, and leave the detailed specifications to the industry participants.

We believe the Commission should further limit the time duration of the beacon to the approximate duration of the event. For example, we believe it is appropriate to limit the beacons to a period beginning no more than one hour before the event and ending no more than one hour after. The purpose of the beacon should be for protection, not for spectrum warehousing.

[4] This would be similar to an existing requirement for satellite video uplinks in §25.281

Protection Eligibility

Today wireless microphones are used for applications ranging from home entertainment, conferences, religious services, to live concerts, theaters, and sporting events. We note[5] that the majority of such uses do not comply with the governing rules of Part 74 which limit legal wireless microphone operators to entities related to TV, radio, and cable broadcast services and motion picture production and TV program production[6].

We further note that the vast majority of wireless microphone uses require only a small set of audio channels. Reserving a percentage of the white space TV channels in each market will provide the necessary resource to accommodate the spectrum need for most wireless microphone usage scenarios. Wireless microphone users will be able to continue using their existing wireless microphone systems and are guaranteed to be free of interference from white space devices when operating on these reserved white space channels. We also want to stress that most of the wireless microphones in the Unite States today use old technology with very poor spectrum efficiency.[7] Limitation on accessible spectrum will also create the necessary market incentive[8] to adopt more spectrum efficient wireless microphone technologies.

While we believe general wireless microphone uses can be adequately addressed by the proposed channel reservation scheme and should not be entitled for further protection, we do recognize certain special events[9] may require additional spectrum resources, at least based on today's wireless microphone technology. In such cases, beacons may be used to claim additional white space channels as needed. One or more beacon transmitters with adequate power level may be placed at convenient high points to protect the event area. Since special events with high spectrum demand are rare in time and location, we believe using high power beacons is a sensible protection mechanism.

Beacons deny spectrum access to other users and should only be used by legal wireless microphone users when it is really necessary. We expect the beacon user to

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[5] *See* ex parte filing of Marcus Spectrum Solutions, LLC, "MSS" 5/5/08 http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520008054

[6] *See §74.832(a).*

[7] The vast majority of the wireless microphones sold in the US use frequency modulation frequency division multiple access (FM/FDMA) technology similar to what was traditionally used for private land mobile systems and first generation cellular systems, except with great spectrum bandwidth to deal with the wider audio bandwidth needed by some, but not all, wireless microphone users. In this digital age of convergence, FM/FDMA operations are becoming a rarity. For example in Docket 99-87 that Commission has directed private land mobile (Part 90) users to transition to the equivalent of 6.25 kHz channels *See* Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended; Promotion of Spectrum Efficient Technologies on Certain Part 90 Frequencies, *Third Report and Order*, WT Docket No. 99-87, RM-9332, 22 FCC Rcd 6083 (2007)

[8] *See* MSS filing, *op. cit*., for discussion on "continuation of status quo will perpetuate inefficient spectrum use." (p.3)

[9] For example, a Broadway show or a major sporting event may require dozens of audio channels.

exhaust all reserved white space channels before using beacons on additional white space channels and make best effort to efficiently occupy all the channels claimed. As a way of deterring beacon abuses, the Commission may consider establish a sunshine beacon registration database where beacon users should report their beacon uses including location, time period, and other information.

Detect and Avoid May Not Be Efficient and Effective for General Wireless Microphone Protection

It is our view that *any* detect-and-avoid method whether using direct sensing or beacons is not likely the right answer to general wireless microphone protection. Detect and avoid is effective and efficient when the primary user signal coverage footprint is significantly larger than that of the secondary user, as in the case of the TV station versus the white space device. High-sensitivity white space devices can reliably sense and identify a white space TV channel and "filling" the white space areas between the co-channel TV service areas. But detect and avoid is not effective and highly inefficient if the primary user coverage footprint is significantly smaller than that of the secondary user, since spot primary user appearances may preclude secondary uses in a larger area, even if the sensing of primary user is perfect. In reality, when a white space device has significantly larger footprint than that of a wireless microphone, sensing is also critical since distributed sensing mechanisms may be required and detection accuracy will be probabilistic in nature.

We emphasize that the above discussion only applies to general wireless microphone protection. For special events, well placed beacons with sufficient power level can provide effective protection for all wireless microphones within the event arena by covering a significantly larger space. From the efficiency perspective, since special events are rare, such over-protection will only result in minimal spectrum waste when averaged over time and location.

As such, we believe the effective way to handle the general coexistence of wireless microphones and white space devices is to designate the two categories of devices to separate sets of white space channels, giving each a percentage ownership of the total white space spectrum. Their relative percentages should be based on their respective average spectrum needs and should reflect their relative economic and societal values. In this way, general wireless microphone users can operate on their assigned channels that are guaranteed to be free of interference, where the desired signal quality can be maintained. White space devices will be able to achieve full operation flexibility with no complicated sensing requirements and uncompromised transmission range that is essential for urban, suburban outdoor and rural area broadband applications.

We conclude by noting the following key facts about the proposed protection method:

Fair. Ultimately, the percentage ownerships of the white space spectrum by wireless microphones and white space devices should be reflective of their respective economic and societal values.

Fail safe. Wireless microphone users can use the designated channels that are guaranteed to be free of interference. For special events, high power beacons will provide channel clearance over the entire event arena and beyond with significant margin.

Easy to deploy. There is no additional cost to general wireless microphone users and in fact, the whole process can be made transparent to them. Today, wireless microphone manufacturers like Shure already provide local channels recommendation on their web site[10]. All they need to do in the future is to limit the recommendation to the white space channels designated to wireless microphones. For special events, the cost of beacon hardware and installation should be minimal comparing to the cost of event organization.

Flexible and nonrestrictive. White space devices can use their designated channels with full operation flexibility without compromising transmission range and dealing with potentially complicated sensing requirements.

We believe the Commission will examine and balance the facts and ultimately decide on a set of rules that will realize the full potential of the nationwide public TV spectrum.

Sincerely,

/s/

Haiyun Tang, Ph. D.

Cc: Julius Knapp

[10] http://www.shure.com/ProAudio/TechLibrary/WirelessFrequencyFinder/index.htm